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Software as a Service (SaaS) Quality Management and Service Level Agreement

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Summary

This paper discusses the finding of a case study concerning the service quality of a Software as a Service (SaaS) application. It was found that while the service level agreement could help guarantee the level of service promised, the service customer would resort to a reactive approach rather than a proactive approach in terms of monitoring the service delivered. In addition, trust and a partnership relationship between the service customer and the service provider are also critical in maintaining the service quality.

Keywords: Software as a Service; SaaS; Service Level Agreement; Cloud Quality Management; Service Quality

Introduction

Software as a Service (Hereafter SaaS) is an emerging software delivery model based on cloud computing. It is the capability "to use the provider's applications running on a cloud infrastructure" via a network, primarily, Internet, through a web browser or a program interface on a pay-per-use basis (Mell and Grance 2009, p.2). SaaS shares the characteristics of every cloud computing delivery model, namely flexibility, scalability, ease of use, and redundancy. As SaaS applications increasingly become an integral part of an organization's IT structure, one important issue is how to manage and guarantee the quality of the service delivered. The aim of this paper is to contribute to this area through presenting the finding of an InterPARES Trust[1] project case study. As one of many child projects of the InterPARES Trust project, this case study examines how the is-

[1] The InterPARES Trust is an on-going multi-national, interdisciplinary research project, which explores issues concerning digital records and data entrusted to the Internet. To learn more about the project, please go to https://interparestrust.org/

sues raised (e.g., the management of SaaS application project, contract terms, cloud contract negotiation, retention and disposal scheduling of electronic records, and privacy protection of personal data) by cloud-based services are being addressed in practice. Case study methodology ensures a contextualized and in-depth understanding of the use of SaaS application within an organization. The chosen case is an e-recruitment SaaS application (*E-Recruitment*) recently launched by the International Federation of Red Cross and Red Crescent Societies (the International Federation) located in Switzerland.

We will present the finding of our analysis of the service level agreement between the International Federation and the service provider of *E-Recruitment* in relation to the service quality: a couple of other factors (i.e. trust, and partnership) that influence the quality of SaaS application will be discussed as well. The remainder of this paper is organized as follows: first, a brief review of literature related to IT service quality management and SaaS quality management is presented; next, the methods for data collection and data analysis and the chosen SaaS application (i.e., *E-Recruitment*) in terms of its functionality and the data it collected and stored are introduced; then, the research findings on service level agreement, trust, and partnership are discussed; the article will conclude by summarizing the main points of this paper and identifying areas for future research.

Literature review

From IT service quality management to Software as a Service (SaaS) quality management

The concept of IT service quality management belongs to the much broader research of quality management. According to the international standard ISO 8402, quality is "the total characteristic of a product or service concerning its suitability to fulfill predefined requirements" (ISO8402). Accordingly, quality management is quality-oriented management aiming to continuously improve the quality of products or services; it "defines quality policies, quality targets, quality controlling and continuous quality improvement within an organization" (Praeg and Spath 2009, n.p.).

IT service quality management is an extension of quality management with a focus on IT service. There are a variety of views on IT services, e.g., components of applications, part of IT organization, set of utilities, and business assets (Spath, Bauer and Praeg 2010). In this paper, IT services are understood as "a set of utilities used by business processes", which can be provided by either an internal or external IT provider (Spath, Bauer and Praeg 2010, p.7). IT service quality management uses a quality management framework to accommodate the different dimensions and views on quality (i.e., both internal and external perspectives {e.g. market developments, customer demands}) and incorporate the different levels of management and managing processes (e.g. strategic, process and infrastructure) (Spath, Bauer and Praeg 2010). It builds on IT service man-

agement frameworks (e.g. IT Infrastructure Library {ITIL}, ISO/IEC 20000, and Control Objectives for Information and Related Technology {COBIT}) yet differs by its comprehensive and thorough view of the quality improvement process.

Quality management process is comprised of four steps: plan, execute, control, and improve (Spath, Bauer and Praeg 2010). In the plan phase, the IT service quality targets will be defined based on an understanding of the business strategy, customer's expectation, and others. Next, in the execution phase, the IT service management process will be evaluated and assessed against the defined targets. Then, in the control phase, possible gaps between the IT service management reality and the targets, and reasons for such gaps will be identified. Finally, proper procedures will be implemented to address these gaps and to improve the overall quality level. In addition to the quality management process, in the IT service quality framework that Spath, Bauer and Praeg (2010) introduced, they mapped different quality methodologies along the IT service lifecycle phase, including requirement engineering, sourcing and procurement, design/test and orchestration, operational maintenance/support, and replacement.

As SaaS applications increasingly become an integral part of an organization's IT service, it is necessary to consider the implications of using SaaS applications for an organization's IT service quality management. Existing studies on the quality of SaaS applications are mostly focused on identifying the SaaS application attributes for quality measurement (e.g., Burkon 2013; Wen and Dong 2013; Khanjani et al. 2014; Benlian et al. 2012). Some may regard SaaS as one type of cloud service, and investigate the attributes of cloud computing as a whole (e.g., Zheng et al. 2014; Thoss et al. 2014). Regardless, recognizing the service-oriented feature of SaaS, a considerable number of these studies draw on the conceptual frameworks of service quality, including the set of attributes concerning quality in a service-oriented environment designed by O'Brien et al. (2007), and SERVQUAL, a multiple-item scale for measuring customer perceptions of service quality developed by Parasuraman et al. (1988).

Though all these studies acknowledge the set of characteristics of cloud computing in general, and SaaS applications in particular to be the foundation to generate the attributes for quality measurement, the way these characteristics is conceptualized differs greatly one from the other. As a result, the same concept may mean different things in different frameworks, and seldom are two sets of attributes exactly the same. In addition, most of these frameworks focus on the non-functional requirements, with functional requirements often unaddressed. What's more, thus far, most studies concentrate on the "control" step of the whole quality management lifecycle (i.e., plan, execute, control, and improve), seldom are there studies that investigate SaaS quality from the whole lifecycle point of view.

Service level agreement

A Service Level Agreement (Hereafter SLA) is "a binding contract between the service provider and the service customer, which outlines the responsibilities, describes the service to be provisioned, defines the service commitment guarantees, penalties for non-compliance, and emergence contacts" (Qiu et al. 2013, p.730). Considering the service-oriented feature of cloud-based service, the establishment of a commonly agreed SLA and the service provider's commitment to the SLA can assure the service customer of the expected levels of service (Sun et al. 2012). It is also a vital instrument helping the service customer define and measure the service level in quality management.

Some of existing studies have identified the main components of SLA. For instance, Baset (2012) states that a typical SLA has the following components: *service guarantee*, *service guarantee time period*, *service guarantee granularity*, *service guarantee exclusions*, *service credit*, and *service violation measurement* and *reporting*. Gulia and Sood (2013) define that the main sections found in most SLA are *definitions*, *performance management* (the service commitments), *problem management* (SLA exclusions), and *remedies* (service credit, and credit request/claim). Despite the differences in the terms used, the two lists are consistent in their identification of several major components: *definition*, *performance* (service guarantee period, service guarantee granularity), *limitation of liability*, *service credit*, and *remedies*. Bon et al. (2007), also propose the minimum contents that a SLA should include *description of service*, *service targets*, *communications and reporting*, *authorization details and validity period*, *financial management details*, *service provider liability and obligations*, *customer responsibilities*, *supporting and related services*, *impact*, *urgency and priority guidelines*, *service hours*, *date exceptions*, *critical business periods and out-of-hours cover*, *workload limits*, *contact details of people authorized to act in case of emergencies*, *actions to be taken in the event of a service interruption*, *escalation and notification process*, *scheduled and agreed interruptions*, *complaints procedures*, *housekeeping procedures*, *exceptions to the terms given in the SLA*, and *glossary of terms*.

Other studies focus on conceptualizing cloud SLA through systematically analyzing publicly available SLA (e.g., Qiu et al. 2013; Gulia and Sood 2013; Baset 2012). These studies usually discuss what attributes are present in these SLAs, what attributes are missing from these SLAs, what attributes should be included in SLAs, and others. For instance, Qiu et al. (2013) summarized that cloud SLA attributes include *responsibilities of parties*, *service definition*, *service guarantee*, *availability definition*, *calculation method*, *monitoring mechanism*, *security policy*, *privacy policy*, *data protection policy*, etc. Qiu et al. (2013) found that *security*, *privacy*, *protection*, and *backup* policies are generally missing in most SLAs.

These studies help reveal the status quo of cloud-based service in terms of what service levels are agreed upon and what are the relationships between service

provider and customer. However, in order that SLAs serve as effective assurance for the expected services, more research is required to both refine the pre-SLA risk assessment and ensure post-SLA monitoring and prediction (Sun et al. 2012). In addition, proactive SLA assurance should be a mutual achievement between the service provider and the service customer, and therefore should be examined from these two perspectives (Sun et al. 2012). This requires us to not only understand SLA in the context of SaaS adoption, implementation, and maintenance, but also in relation to the whole lifecycle of quality management.

Methods

Data collection and data analysis

In order to gain an in-depth understanding of the adoption of a SaaS application and how the issues raised by the use of a SaaS application are addressed in practice, multiple methods have been used to collect data, including policy analysis (e.g., information security classification standard, ICT security policy, and cloud services request form), contract analysis (e.g., terms and conditions, and service level agreement), system analysis, and semi-structured interviews. Data collection started in December 2014 and ended in February 2015.

Ten interviews were conducted with staff from the legal department (2), library and archives unit (1), IT department (1), the human resources department (5), and risk and audit department (1). Five interview guides were developed prior to the interview for staff from each department. While in general the interview questions prompted interviewees to describe how the issues raised by the use of this SaaS application were mitigated, depending on the role and responsibilities of each interviewee in the adoption, implementation and use process, interview questions were geared towards the area with which each person is familiar, to ensure a comprehensive understanding of the adoption, implementation, and use of this SaaS application. For instance, the staff from the IT department, who is also the project manager of the *E-Recruitment* project, was asked to discuss more about the management of this SaaS application project, contract negotiation process, and the organization's cloud strategy.

Each interview lasted between 25 minutes to 90 minutes. Interviews were audio recorded and transcribed afterwards. All personal identifying information was removed; each interviewee was assigned a unique identification number, e.g., interviewee1, interviewee2. A thematic analysis was performed on the data collected. Reports on the research has been sent back to the International Federation staff to do an accuracy check.

The SaaS application

Formally launched in January 2014, *E-Recruitment* is one of several SaaS applications that the International Federation has adopted. It is a public-cloud based e-recruitment application aiming to streamline, standardize, and improve the recruitment process. Consistent with the recruitment process, the core func-

tionalities of *E-Recruitment* include creating a new job opening, approving the new job opening, advertising the job opening on internal and external career pages, selecting the preferred candidate, and making an offer. Types of information collected and stored by *E-Recruitment* include candidate data (e.g., name, address, CVs, references, and application data), contract data, notes on the interviewing and evaluation of candidates, policies and guidelines, job description, and career information on the public website.

Finding

Service level agreement

The contract between the International Federation and the service provider of *E-Recruitment* is comprised of the following documents: order form, terms and conditions, terms and conditions for other services, service level agreement, and documentation of the functionalities provided by the service provider. To understand the service level agreed upon between the International Federation and the service provider, we conducted an analysis of the SLA against the conceptual SLA framework identified by previous research studies. More specifically, two analyses were conducted: one on the components of SLA and one on SaaS quality of service attributes.

The analysis of the major components of the SLA between the International Federation and the service provider of *E-Recruitment* shows that, on the one hand, the sections identified by previous studies are all valid as they are all present in this SLA, albeit, in more detailed forms (e.g., *performance*); on the other hand, the analysis reveals that some lists identified by previous studies are not sufficient. For instance, while the list of contents identified by Bon et al. (2007) is able to accommodate all the sections in this SLA, the rest of the lists are not adequate in that they may fail to identify a couple of other sections, e.g., *maintenance, customer's responsibilities,* and *support*.

In terms of *performance*, previous studies indicate that it specifies the service metrics a provider strives to meet, including *availability*, *response time*, and *disaster recovery*. In reality, it can cover a wide range of metrics, including *availability*, *response time*, *security* (*data center security*, *data center environment*, *data center network*, *monitoring*, *system backup*, *data security*, and *disaster recovery*), *data recovery*, and *acceptable use policy*. In terms of the *customer's obligation*, this describes the responsibility on the customer's part to ensure the performance of the application, e.g., providing necessary computer system, hardware, software, and telecommunication equipment, installing necessary virus protection software, upgrading its system regularly, and others. The *maintenance* section outlines the *maintenance schedule*, *notification*, *test of the release*, *training*, *influence on the existing setup and data*, and *emergency patches*. The *support* section basically outlines the method and lifecycle of incident resolution: *incident notification*, *incident severity classification*, *incident reporting*, *incident response*, *incident resolution*, and *escalation procedure*.

The inclusion of *maintenance* and *support* in an SLA is necessary. One reason that users prefer SaaS applications is that software upgrades will be delegated to the service provider, which not only guarantees the quality of the application, but also saves users from the lengthy and costly upgrade process. As a service-oriented computing model, *support* should be an essential part of the service provided. With very limited control of the application and the underlying infrastructure, the customer largely relies on the service provider to fix any issues arising in the use of the application.

The analysis of the International Federation's SLA regarding the SaaS quality of service attributes yielded different results. For instance, the list of quality of service attributes identified by Qiu et al. (2013) works very well in the sense that the majority of them are present in the SLA, including *responsibilities of parties*, *availability definition*, *calculation method*, *monitoring mechanism*, *violation penalty*, *violation penalty onus*, *remedy calculation*, *termination policy* and others. The few attributes that are absent from the SLA are *change control*, *privacy policy*, and *service definition* (there is a separate document focusing on documenting the functionalities offered). However, some of attributes (e.g., *interoperability*, *modifiability*, *usability*, *testability*, *resiliency*, *composability*, *extensibility*) identified by Khanjani et al. (2014) and Burkon (2013) are not present in the SLA as these are abstract attributes that usually subject to different interpretations. This means that though the SLA can serve as a good source to evaluate the quality of service of the service provider, the SLA alone is not adequate to determine and guarantee all the quality of service.

Trust

Once an SLA is agreed upon and signed by the service provider and the service customer, a benchmark is established against which the service customer can assess the service delivered and claim for remedies where service failure is detected. However, the post-SLA assessment of the service level might not be as easy as expected. One of the primary difficulties is that customers usually do not know how to monitor the service promised. Cloud monitoring is of vital importance for both cloud service providers and cloud service consumers, as, on one hand, it can assist providers in operating and managing cloud service in order to continuously adapt to customers' demands; on the other hand, it provides information and Key Performance Indicators (KPI) so that consumers can see the service they received (Aceto et al. 2013). There are many cloud operational areas requiring cloud monitoring, such as accounting and billing, SLA management, service/resource provisioning, security management, and fault management (Fatema et al. 2014). Yet, thus far, there are insufficient studies on cloud monitoring (Aceto et al. 2013). Analyses of general-purpose monitoring services (e.g., Nagios) and cloud monitoring services (including provider dependent monitoring services, e.g., CloudKick and provider independent monitoring services, e.g., Monitis) show that "current monitoring tools are least sup-

portive of security and privacy assurance management in Clouds" (Fatema et al. 2014, p.2928).
In the case of *E-Recruitment*, cloud monitoring is absent from the cloud services management portfolio. This lack of technical assurance is balanced by several other factors: trust, due diligence in the selection of the service, not putting highly sensitive information in the cloud, the SLA, and others. Among these, trust is one of the most intangible factors and is often associated with a reactive approach in SLA commitment monitoring and potential risks. The risk of misplaced trust in a service provider can be very high if due diligence on the part of the customer is absent, but in this case the risk of trust being misplaced is limited due to the factors listed above.

Partnership
Technically, there is a customer-provider relationship between the service provider and the service user. And as per the SLA, the service provider has the responsibility to deliver the service promised and provide remedies where promises are unmet. But in reality, according to our interviewees, the customer and provider work more like partners in the delivery of the SaaS application.
One common term in SLA is service credit, which usually is expressed as a percentage of the weekly, monthly, or yearly subscription fee and will be credited to the next invoice. The onus is often on the customer to claim the credit within certain time period. From the customer's perspective, they want the service purchased to perform well all the time. But from the provider's perspective, certainly, they will not feel comfortable with committing to one hundred percent performance. As a result, the service provider often uses service credit as an option to compensate any service failure. But for the customer, service credits certainly cannot compensate for whatever the organization might suffer from the service failure. As interviewee4 observed,

> "This is why the relationship side is more important than the contractual document. It is really working on how you make that relationship work, what you get out of them, how you shift the balance of power, what respective benefits both parties get."

Indeed, the willingness to enter a five-year contract in this case requires flexibility, and cooperation from both parties to make this relationship work and to guarantee the quality of the service delivered. For instance, immediately after *E-Recruitment* went live, there were some issues with the service provider's platform. As a result, the International Federation experienced a series of incidents with *E-Recruitment*. To make matters worse, there were some issues with the communication with the support desk because of the way the ticketing system worked. An incident report would go from one level to another, in a long process to finally reach the support technician who could help resolve the issues.

As interviewee7 commented, they were not satisfied with the service at that time. The International Federation discussed the issues with the service provider, which took them seriously. As a result, not only the International Federation got the service credits they deserved but also the communication channel between customer and service provider has been modified so that the International Federation can now contact the support technician directly concerning any technical issues.

Conclusion

In comparison with previous software delivery models (e.g., in-house developed software, and Application Service Provider-oriented application {ASP}), SaaS applications have some unique features which require special consideration with regard to service quality management. As a binding contract, the SLA outlines the service level service providers should deliver and customers should expect. But the fulfillment of the SLA requires proactive monitoring of the service, which the customer might not know how to carry out. More research is needed to develop a customer-friendly service monitoring tool. Moreover, SLA is simply one link in the chain of the quality management process. To obtain high service quality requires due diligence in the selection of service, negotiating a balanced contract, and other procedures. A good understanding of SLA will be gained if it can be situated in the context of the SaaS application adoption, implementation, and use lifecycle.

In addition, our research found that service quality often relies on more than contractual documents. Trust and a partnership relationship also play an important role in guaranteeing and improving the SaaS application. Future research is needed to explore the relationships of different factors in the service quality of SaaS application, e.g., trust, partnership, contract, due diligence in the use of SaaS application and others.

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